UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

FIRST CONSULTATION ON THE FISHERIES INDUSTRY

Gdansk, Poland, 1 – 5 June 1987

Distr.
LIMITED

ID/WG.467/1
15 April 1987

ENGLISH

Issue Paper I

IMPROVEMENT AND MODERNIZATION OF BOATS AND FISHING EQUIPMENT TO INCREASE PRODUCTIVITY AND EFFICIENCY*

Prepared by
the FAO Secretariat

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V.87-84324

SUMMARY

The paper identifies issues facing the harvesting sector of the fishing industry and the economic activities it generates. Measures taken to develop the industry must be tailored to the social and economic situation in each country and must take into account the fishery, manpower and material resources available.

Most developing countries have relatively large artisanal fishing sectors whose needs are quite different to, and sometimes conflicting with, the needs of the commercial fishing sector. This is evident in their traditional methods, their geographical distribution, and their general lack of capital and formal technical skills. Yet this group produces as much as 95 per cent of the fish in some major fishing countries of the developing world.

Development of large-scale commercial fishing enterprises and their supporting industries appears to be easier at first glance, but caution must be exercised before investments are made. A fishing fleet, shipyard, net factory or engine assembly plant is but one-eighth of the industrial "iceberg". The other seven-eighths, which are not visible, is the supporting network of skills, services, spare parts, communications, supplies and commercial facilities which make the operations viable and help to maintain them.

Small-scale manufacturing units, in contrast, mostly require an intermediate technology which is much less dependent on other factors. But to acquire such appropriate technology may not be easy when the industrialized countries are geared to sell the most modern or advanced types of machinery.

Thus training and the transfer of appropriate technology are vital elements in any programme of industrialization. Credit availability will also be a factor particularly when the products are for sale to the small-scale fisheries.

The issues are complex and often inter-related. No one formula will suit every situation, and each one should be viewed on its own merits. Careful study and considered selection of sectors and technologies for investment by governments and funding agencies will be rewarded with profitable industries and flourishing fisheries.

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A. INTRODUCTION

1. Fish production as a primary industry supports a whole range of ancillary industries in manufacturing, servicing, provisioning and maintaining the harvesting operations. In some countries, for every job on a fishing vessel there are as many as ten jobs created in support industries ashore. Both sectors are linked and in many cases depend on each other for their existence.

2. As the technical, economic and social requirements of the fishing industry change, so each support industry must adapt and update its operations if it is to effectively serve the fishery. The particular improvements needed in each country may differ according to the stage of development, type of fishery, social needs, material constraints or government priorities.

3. This paper summarizes the issues and changes, both forced and desired, which are likely to be required in the future with respect to the various sectors of the harvesting side of the fishing industry. Areas are also identified in which industrial development might be needed in developing countries if these changes are to take place. The dangers or pitfalls facing any industrialisation programme for fisheries are outlined. Careful consideration needs to be given to economic, social and technological factors to avoid wasted or unnecessary investment.

4. Similarly, the resource base of each fishery must be considered when making investments. Expansion of the fishing effort is not wise when production from any one fish stock is close to the optimum yield.

B. SMALL-SCALE FISHERIES

Background

5. Small-scale or artisanal fishing predominates in the developing world. These fisheries are characterized by high labour involvement, low capital investment, low levels of mechanization, and mainly passive methods of fishing. FAO estimates put the number of full-time small scale fishermen at around 10 million, and there may be another 5 million part-time fishermen. Together they produce over 20 million tons of fish a year, almost all of which goes for human consumption. There are probably as many as 3 million small-scale fishing boats, varying from log kattumarams through dugout canoes to relatively advanced small high speed craft. In the main, however, only a fraction are mechanized.

6. Although the artisanal fishermen are skilled in traditional methods of fish capture, their equipment is mostly simple and in some cases quite primitive. This is partly due to the lack of

capital and partly to the high investment and operating costs of some modern items of fishing gear or equipment, and the fact that not all innovations are appropriate in all cases. In general, synthetic ropes and nets are well accepted and have been used by small-scale fishermen for several decades. Propulsion engines are popular among those who can afford them, but winches, pumps and deck equipment are used by only the most advanced of artisanal fishermen. Electronic aids are similarly not in widespread use as yet. Apart from financial constraints to procurement and operation, very few of these fishermen live near workshops or servicing depots, particularly for hydraulic or electrical equipment, and many of them have had no technical instruction or exposure to these technologies.

7. Possible improvements to small-scale fishing industries lie in the fields of boat construction and mechanization. However, one of the major problems in stimulating artisanal fisheries to develop further lies in their scattered rural nature. One is faced with the need to promote the establishment and improvement of thousands of village level businesses to install, repair and service machinery or to actually construct or assemble basic units. Nevertheless, for a number of reasons changes must take place and these are discussed further on in this paper.

Technology and Energy Needs

8. It is now generally accepted by governments and development organizations that the small-scale fisheries of the world should not be viewed in isolation but rather as an integral part of their communities. For this reason, an integrated approach to artisanal fisheries development is now preferred. This involves among other things the encouragement and stimulation of ancillary village industries which include boatbuilding, net making, blacksmithery, marine mechanics, and the production of ice and packaging materials for fresh or cured fish.

9. If such village industry is to be encouraged, then great care needs to be taken in the choice of technology and the scale of production selected for a given production. The final cost of the product should not be the major determining factor. For example, it is possible to reduce slightly the cost of fishing boat hulls in some countries by manufacturing in GRP at a central plant. But that may have several unwelcome side effects. It would put many local village boatbuilders out of business, it would make local repair and maintenance difficult, if not impossible, and it would involve a large foreign currency element in the cost.

10. Thus, with some obvious exceptions which will be discussed later, technologies selected for artisanal sector industries should be such as can utilize local artisanal skills and locally available materials. In this way the whole fishing community can become economically healthy. Otherwise, despite a productive fishing fleet, a fishing village bleeds to death

economically as less and less of the production income is spent in the locality.

11. There exists considerable potential for tapping local natural or renewable sources in the selection of energy for small-scale fisheries. Most small-scale fisheries power needs are modest and therefore energy sources which would be inadequate for the commercial sector can be usefully and economically utilized for capture, processing or transport.

12. In 1981 the Asian Development Bank staged a workshop to draw attention to the possible application of non-conventional energy systems to artisanal fishery projects. Among the energy systems found to be applicable to artisanal fisheries were wind power (for vessel propulsion and water pumping), solar power (for fish drying, salt production and cooling), producer gas from charcoal (to drive diesel or gasoline engines), alcohol (to fuel gasoline engines), methane or biogas (to drive engines or provide lighting) and agrowaste (as fuel for stoves and boilers). No one alternative source could compete with petroleum for ease of use or versatility, but an appropriate mix of alternative energy could provide power for a fishing community at a fraction of the capital and operational costs of petroleum based systems.

Boat Building Materials

13. Traditionally, practically all small fishing boats have been built from tropical hardwoods. The most basic canoe, the dugout, has required very large trees for its construction. These large trees, and tropical hardwoods in general, are becoming scarce and there is a growing worldwide awareness for the need for conservation of the forests. There is little likelihood of supplies of suitable timber being available in the quantities required in the near future, and for this reason new boat building materials and methods will have to be introduced. These may be related to construction in glass reinforced plastics (GRP), ferro-cement, steel, or even soft woods, properly cured and well preserved, as well as marine plywoods.

14. While the use of these materials will make the small-scale fisherman more dependent upon the manufacturing and support industries, opportunities will develop for the introduction of manufacturing processes in some countries.

15. In countries where boatbuilding timber is still available there is need to produce non-corrosive fasteners. Much valuable quality timber is wasted because easily corroded nails and bolts are used. The vessels so constructed last only half as long or less than they would if proper fastenings were used. These include copper nails, brass or bronze bolts and galvanized nails and bolts. The introduction of simple zinc baths would be a big improvement to small boat yards, as would be the supply of brass, bronze and copper fittings.

Mechanization

16. Most artisanal fishing boats are propelled only by sail or paddle and, indeed, many will continue to be powered in this way for many years to come. This is inevitable, since most artisanal fishermen are landless, relatively poor, and they do not attract credit easily. In addition, mechanization may not be appropriate technology for social and economic reasons. However, in some cases mechanization is desirable and appropriate and this is particularly so in competitive circumstances. Nevertheless, mechanization programmes must be carefully prepared, they must not decrease employment opportunities for the fishermen and increase reliance on fossil-based fuels with the attendant problems of cost and availability. Similarly, the availability of supplies of equipment, spare parts and service as well as training programmes for the transfer of new technologies must be assured.

17. Experience in meeting the above-mentioned problems is available and FAO is currently working closely with manufacturers on the introduction of low-powered fuel-efficient diesel engines in small craft, mechanization of fishing gear handling and in the use of alternative energy to fossel-based fuels.

Standardization

18. By the very number of units involved, the mechanization of small-scale fisheries lends itself to standarization and the fishermen should benefit from low manufacturing and operating costs. However, selection of the technology on which the mechanization will be based must be sound and appropriate. Too many times in the past the introduction of unproven vessels, too sophisticated equipment or energy expensive motors has done much harm and resulted in disappointment or disillusionment. Technologies must be readily absorbed by the local pool of skills and in general materials should be locally available. Such technologies must be economically viable, and not create more costs than income.

19. Admittedly, standardization responds to a large demand and is best determined nationally or regionally, but it must be arrived at carefully on the grounds of power requirements, vessel types and size of market. Past attempts have not been encouraging but an example of how to approach standardization of marine engines is seen in the meeting held in Sierra Leone (15-18 November 1986) between representatives of government, fishermen, industry and FAO advisors. The precise needs of the fishing fleets were examined together with maintenance and repair service requirements, narrowing the field down to a few suitable propulsion units. As a result, industry is cooperating in further adapting their units to local needs, having been made more aware of the market. Of course, standardization should not

result in a monopoly situation and it is encouraging that a number of manufacturers are interested in the potential market.

Equipment for Small Vessels

20. Very few of the 3 million small-scale fishing craft in the world are equipped with a magnetic compass. This is surprising when one considers that it has been a basic tool of seafarers for hundreds of years, and that it is relatively cheap and easy to use. As governments begin to pay attention to safety at sea as regards artisanal fleets it is likely they will encourage greater use of basic navigational aids like the compass.

21. Vessels which are large enough should also carry lights and if mechanized a small alternator and battery. These are simple items but they can represent a considerable advance for many artisanal fleets. Bilge pumps, either manual or powered, would also be a good safety feature. Although for most artisanal boats manual pumps would be adequate.

22. If electrical power is available, then the way is open to introduce depth sounders or fish finders. Modern transistorized or silicon cell units are remarkably compact and relatively cheap. The time may now be ripe to introduce basic low-cost units which would be useful both for navigation and for fish location provided that after sales service can be assured.

23. However, the adoption of internationally developed guidelines for safety, for training and navigation, would normally be incorporated in the fisheries laws of the States. This in itself would call for some form of control and an increase in the strength of fisheries administrations, more surveyors for example, all of which would add to the costs of managing a fishery. In the same way, small-scale fishermen would be exposed to higher operational costs without, in some cases, the guarantee of higher incomes. Therefore, care must be taken by government, multilateral and bilateral agencies, to minimise the financial burden which might be created by the upgrading of the harvesting sector of small scale fisheries.

Employment

24. If some countries with important but vastly differing fisheries are taken as examples, it can be seen how greatly employment factors differ:

	Fish production 1984 (in tons)	Number of fishermen	Post harvest workers	Nos.employed per thousand tons caught
U.S.A.	4,142,000	223,000	110,558	80
Norway	2,455,000	28,000	15,000	18
Indonesia	2,217,000	1,100,000	600,000	766
Mexico	1,103,000	120,000	70,000	172
France	738,000	21,000	11,000	43
Nigeria	373,000	250,000	166,000	1,115
Mali	54,000	45,000	30,000	1,200

25. From the above figures (which do noc include fish farmers or ancillary industry workers) it is clear that per ton of fish caught, developing countries employ many more people than industrialized states. The numbers finding work in the capture and post harvest sectors can be ten or twenty times as much as in a similar-sized fishery in a developed country. The table does not include personnel in manufacturing, finance and servicing, which would probably show less disparity, but the broad picture remains the same. Mechanization and improvement of a fishing fleet will create more jobs in shore industries, but not to the degree that would be necessary to employ all redundant fishermen if the whole fleet in a developing country were to be improved for the purpose of reducing the size of crews. Technologies to be introduced in the artisanal fisheries will have to be labour intensive for a long time to come. This is true for most but not all developing states and the degree of mechanization selected will have to be balanced with the available manpower. Some governments, such as Malaysia, do plan a reduction of overall manpower in their fishing industries, but provision is being made to redeploy the excess manpower. In the case of Malaysia, the reduction was planned in order to reduce fishing effort so that the fish stocks would be conserved.

C. COMMERCIAL AND LARGE-SCALE FISHERIES

Background

26. The number of new vessels being built for the commercial/-large-scale fisheries sector of developing countries is increasing and it is evident that in some cases the replacement of existing vessels which are old and/or obsolete is overdue. Argentina is one such country which foresees a substantial replacement programme, whereas Morocco, Angola, and Thailand have current new building programmes.

27. The size of the new vessels and technology level is determined by functional requirements and the range, power and capacity needed to prosecute a given fishery. Currently many industrial fishing vessels in developing countries differ from those in the developed countries in crew facilities, electronic

aids and mechanization, but this need not be the case in the future. International requirements on standards of construction, accommodation and safety will tend to lead to improvements. In the same way, requirements for the insurance of vessels, cargoes and crews will force change.

28. The technical and economic problems faced by operators in operating and maintaining these vessels are quite serious in countries lacking their own or nearby facilities; the problems being compounded in seeking services in another state when foreign exchange restrictions are in force. Since technical services are and will continue to be essential, the development of local facilities are vital and the extent of this development should be weighed against future demands; large facilities for a small number of vessels might not be cost effective unless other work can be attracted. More specific areas for consideration are discussed below.

Vessel construction

29. Although the production from capture fisheries is unlikely to grow substantially, production units need to be maintained, refitted and eventually replaced. The current building programmes in some countries mentioned above are not directly linked to replacement needs but more to an expansion of local interests. Whereas the case of the Argentine having to consider rebuilding, stems from the fact that the vessels of the fleet have an average age of more than 20 years. The rate at which new building will take place will of course vary from country to country, but there will continue to be a need for new vessels.

30. In parallel with the new building programmes, there is a trend towards more selfsufficiency in developing countries. In Asia and South America, many countries have the necessary basic facilities for ship building. Some developing countries are also building for export, as is the case, for example, in Brazil, Guyana, Ghana, Rep. of Korea and Singapore. Many of these shipyards started from foreign ownership or joint ventures and in most cases external assistance, both financial and technical was given. However, most are still dependent upon imported materials and in some cases assistance in design is still needed.

31. Other developing countries, are now insisting on the local construction of all fishing vessels and, while existing facilities might be adequate for small vessels, this is not necessarily true for the larger units, and further development will be required. New skills as well as equipment will be needed and such development of shipyards and support industries must be considered in the light of the overall development plan of the country. Joint ventures can play a role in assisting local yards to construct larger or more complex vessels, and to train their personnel for these more demanding tasks.

Vessel Machinery and Equipment

32. The engines, winches, refrigeration machinery and electronic equiment on a modern fishing vessel are powerful complex units that require skilled and well equipped factories to produce. It is unlikely that the fishing industry in any one developing country could justify local production of large propulsion engines. The manufacturers of those engines find the bulk of their sales in non-fishery fleets which include tugs, cargo vessels, ferries, patrol craft, coasters, oil-rig tenders, naval vessels and power stations. Only if a country has a sufficient total demand for large engines of a given size could it consider negotiating with a company to manufacture or assemble such units locally.

33. Small engines are another matter as these have widespread applications such as propulsion units, auxiliaries, and drives for agricultural pumps and machines. It may be relatively easy to arrange for local assembly or manufacture of these engines and this had been done for example in Bangladesh, Brazil, India and Singapore.

34. Winches, capstans, power blocks, line haulers and windlasses could easily be produced under licence in developing countries. Hydraulic systems as an example have become simple and reliable making their widespread adoption by developing countries overdue. Nevertheless it is important to ensure that reliable trained mechanics or engineers are on hand in each major port to service the equipment.

35. Electronic equipment, on the other hand, requires a big market to justify establishing a factory. There could be a case for regional manufacture with work shared as far as possible between neighbouring states. This is already practised in Asia, where large corporations control sub-manufacturing units in a number of developing countries. However the problem of servicing could become more serious as operators become more dependent on electronic aids to maintain fishing effort. Therefore any development in the establishment of such electronic manufacturing units must consider the responsibilities to the end user.

D. MAINTENANCE AND SHIP REPAIR FACILITIES

Background

36. Repair and maintenance facilities are an essential component of the fishing industry, yet planners and investors do not always recognize the diverse requirements of the commercial and artisanal sectors. This is particularly so in the case of the more remote fishing villages where the level of skills and the tools available barely meet the basic needs of the fishermen.

37. There are many reasons for this situation but the difficulty in attracting credit is common to both sectors and it is a factor which needs to be given greater priority if even present harvesting levels are to be maintained. In fact, many of those serving the artisanal fishermen face insurmountable problems since they are rarely able to furnish the guarantees required by the lending institutions.

38. The lack of suitable repair yards and workshops does not simply result in poor maintenance, it threatens the very existance of the operators and those on board fishing vessels. On matters of safety and seaworthiness, a greater range of fishing vessels now fall into one category or another covered by international conventions, national legislation, as well as the requirements of classification societies and marine underwriters. Adequate servicing facilities are essential if vessels are to comply with regulations. Failure to comply could lead to a vessel being legally prevented from going to sea.

Large-Scale Vessels

39. With regard to the commercial and large-scale fisheries, maintenance of the hulls requires substantial drydocking or slipping facilities, and these are not always associated with the shipyards building new vessels. As a consequence, the vessels of some developing countries are forced to seek repair facilities elsewhere, which invariably demands the use of scarce convertible currencies. However, as with new construction, repair yards must have a continuous flow of work to be self-supporting and this is rarely achieved through servicing the fishing industry alone. Indeed, of all vessels over 100 GRT, only about a quarter of the 88,000 vessels so registered are fishing vessels.

40. It would not be practical to pursue self-sufficiency in drydocks and slipways in every developing country. Some governments, however, may find it necessary to provide such facilities and to cover the operational deficit in order to ensure that its fleets of vessels continue to fish; in some cases, the foreign exchange earned on fish products might lead to an overall profit. Others may decide to use neighbouring facilities, but whatever the case may be, vessels operating from ports in the flag State must have adequate repair shops to cater for other maintenance needs.

41. It would also be necessary to ensure an adequate supply of spare parts to be held in the country in order to reduce time due to breakdowns and routine maintenance. In addition, the more sophisticated the vessels, the greater the diversity of technical skills needed to service the equipment.

42. Apart from the above, governments and institutions must provide the necessary marine surveyors to ensure that the repairers and service engineers carry out their work in an approved manner and to ensure that operators meet the required

safety standards. Countries with fleets of cargo and passenger vessels are likely to have resident surveyors but in many countries operating fishing vessels, this may not be the case. There is then the need to rely on surveyors from elsewhere until such time as nationals can be trained and become experienced enough to take over the responsibilities of a survey office.

43. The training of local labour is also essential since common sense dictates that while manufacturers have a responsibility for after-sales service, many of them cannot possibly service every country in the world. This is not however easily achieved, since a modern fishing vessel incorporates many different types of equipment requiring a wide range of skills to maintain, as can be seen from the following:

i) engineeers with university/technical institute education are required in the fields of naval architecture, refrigeration, hydraulics, cathodic protection, paint systems, electronics instrumentation and propulsion machinery;

ii) tradesmen with at least four years of an apprenticeship coupled with studies at a trades school or following a City and Guilds of London type course are needed as joiners, carpenters, fitters, welders, plumbers, platers, blacksmiths, riggers, painters and coppersmiths or brazers;

iii) specialists having served an apprenticeship and having undergone further applied training are required for the shot blasting of steel, application of epoxy resins, insulating refrigerated rooms and for the fumigation of vessels;

iv) administrative support personnel with good general education are needed to maintain the accounts, purchase materials and control stores; and

v) in addition there are government and classification surveyors employed to ensure that shipbuilding and ship repair yards meet the standards of work and safety requirements and these surveys have undergone considerable professional training.

44. Most of the above, by the nature of their skills, require equipment and tools that together amount to a formidable investment cost for the shipyard. The professionel workers are of little value without the specialists and tools and vice versa. Both the capital cost of equipping skilled workers, and the training cost of producing them should be borne in mind when planning shipbuilding and repair investments. The training would require the support of comprehensive technical colleges and training institutions.

Small-scale fishing fleets

45. Unlike the commercial sector dealt with above, the number of artisanal fishing boats in developing countries outnumber those engaged in other pursuits; and for many of the repair workshops, the fishing industry is their sole source of livelihood. Unlike their bigger sisters, small boats are less likely to be able to take advantage of repair facilities in other countries. The need for repair shops is just as important however and the closer these are to the fishing villages the better. Service facilities vary from the basic clearing in a village or on a beach with barely a sun shade, to rather well set up workshops with lathes, drilling machines and such like. Similarly, the degree of skill required varies greatly.

46. Whatever the requirement, no development programme can be effective without assuring the service of the craft and equipment. This of course, is easier said than accomplished since he who carries out the repairs is often no more credit worthy than the fishermen he serves, nor is he likely to be any better educated. It follows that the desire to mechanize and invest must be tempered by acceptance of current limitations and of the rate at which the industry can be trained to maintain and operate new equipment coupled with the impact such as upgrading would have on the community as a whole.

47. In addition, the introduction of new technology and equipment could, in some cases, lead to unacceptable maintenance and operational costs. For example, echosounders and navigational equipment utilising new technology in this age of electronics can be relatively expensive to maintain. Indeed, the cost per hour of a service engineer can be as high as US$100 if sent from the factory and even agents in developing countries charge in excess of US$50 per hour plus expenses! Not all service facilities are as expensive, but all are costly in relation to a fish finder for a small vessel which can be as low as US$350.

48. Therefore, whilst the purpose of this paper is not to give advice to manufacturers on how to give service, it is obvious that in the case of low-cost items some sort of replacement scheme should be considered in conjunction with a minimum charge.

49. Other needs have been mentioned already but it would not be imprudent to repeat these to emphasize areas in which improvement could be made.

i) small boat repair yards requiring basic skills, hand tools and the minimum of machinery;

ii) slipway facilities for boats not readily beached requiring a modest level of investment in civil engineering works and machinery;

iii) outboard engine service facilities for which mainly hand tools are required but for which a good and steady supply of spare parts is essential;

iv) covered workshops for the maintenance of inboard diesel engines and stern gears requiring light machinery and specialized test equipment for fuel systems;

v) electrical repair workshops for which basic, hand-held test equipment and hand-tools are required; and

vi) for the more advanced fleets, electronics engineering workshops which need a higher degree of knowledge/-education, and more expensive test equipment than required for the electrician.

50. Often, the above requirements are met under one roof but this is certainly not always the case and, as has already been noted, the remoteness of fishing communities often presents difficulties which are not readily overcome.

E. FISH HANDLING ON BOARD AND UNLOADING

Background

51. Fish handling on board fishing vessels in both artisanal and large-scale commercial fisheries, and subsequent unloading on beach or landing places influences fishermen's earnings to a varying extent. In many developing countries, prevailing inefficient practices lead to deterioration of the quality of the fish landed, increasing losses through spoilage and elevating the cost of the operation.

52. The technology of on-board handling in small-scale fisheries is normally simple, involving only a little training and relatively small capital investment, which in most cases should be recouped in higher earnings from better quality landed fish and the reduction of post-harvest losses. On the other hand, appropriate developments in bulk handling and on board preservation in the large-scale commercial fisheries of the developing countries have not kept pace with the rapid development in the catching techniques applied to these fisheries, particularly for the schooling small pelagics that might be intended for human consumption. Most of the catches, therefore, are often landed in a bruised and decomposed state and hence destined for reduction to fish meal with a result of economic loss.

Fish handling

53. Properly designed containers, boxes, etc., made of materials which are impervious and easily cleaned are essential. The manufacture of these in developing countries has attractive economic prospects.

54. A basic principle in maintaining fish quality is to cool fish to ice temperature as soon as possible after leaving the water. This applies to any fishery. Unless fishing trips are of very short duration, fish must be chilled on board. Insulation of fish holds on larger vessels or the use of insulated fish boxes in smaller boats would promote more efficient use of ice. Local industries can be trained and encouraged to manufacture insulated boxes and install fish hold insulation in fishing vessels of any size. In some cases it may be wise to consider the installation of refrigeration units to conserve ice especially on voyages to the fishing grounds.

55. Incorporation of chilled sea water or refrigerated sea water systems on board fishing vessels, is used in some large-scale commercial fisheries and this reduces physical damage and creates fast cooling at the same time. Such systems require servicing and maintenance.

Unloading

56. Unloading of the catch should be carried out quickly, economically and with as little damage to the fish as possible. Simple derricks and capstans, either on board or on the pier, could speed up the process greatly at very little cost. Various mechanical conveying equipment exists and some can be made in simple forms. Small local workshops could easily cope with this type of mechanization.

57. Adequate supporting facilities and relevant services available to fishing vessels at landing places can contribute much to the effective unloading of the catch to the benefit of all involved. Investment on such infrastructure by the government is very essential.

58. In many fish markets in the developing world, the fish are not weighed. They are measured in volume using a standard local basket or container which is accepted to contain a certain weight or number of fish of a certain size when full. This popular and general practice has made the introduction of proper scales in fish markets mostly unsuccessful. Conventional scales can be manufactured locally, and although these would be expected to provide merchants and fishermen with a more accurate measure of the catch, the need for such an introduction should be properly ascertained.

59. The introduction of clean water, scrubbing brushes, good drainage and a strict cleaning regime would probably do more for fish quality control than any other investment in fish markets in developing countries. Provision should also be made to wash all fish going to the market in a properly designed washer using potable water or clean seawater.

60. Fish graders are useful at landing places and the separation and selection of fish could result in higher prices for the fishermen. However, grading machinery has not been widely used and accepted in the developing countries. The machinery is simple and can be driven by electrical or mechanical power units. The bulk, if not all, of the equipment can be fabricated locally. Its introduction, however, would have to take into consideration the acceptance and implication of the prevailing local fish trade practice.

F. CONSUMABLE ITEMS AND THEIR MANUFACTURE

Background

61. Most fishing gear is now made from synthetic materials, which are an important by-product of the petroleum industry. Any increase in basic oil price affects the fisherman's gear costs as well as his fuel costs. For fishing nets, the synthetic fibres chiefly used are polyamide (nylon) and polyethylene. (Polyester and polypropylene are also used but to a lesser degree.) They are poduced in granular or pellet form which is then turned into a continuous fibre. The fibres are subsequently spun into twines and made into ropes and nets.

62. The few developing countries fortunate enough to possess oil reserves and a refinery industry may contemplate establishment of a complete manufacturing line for netting twines and ropes. Others could follow the example of some developed countries and import the granules. In both cases, however, the investment costs would be considerable since the manufacturing machinery is expensive. Additionally it is currently a highly competitive market and logically not all countries can be self-sufficient, but all could produce some items of fishing gear. There may be a case for establishment of regional factories supported by a number of countries as could be the case with economic communities.

Net-making

63. Developing countries and particularly those with small-scale fisheries could expand their cottage industries through the use of hand-operated looms for net making and simple aids to rope making. Twine would have to be imported but the looms could be readily constructed locally and although all of the needs might not be met, the benefits to the communities and the economy could be considerable.

64. In some cases the use of complex, automated looms might be justified on the basis of the demand for netting. This would need considerable investment capital and training and some countries have taken this step successfully. Others, however,

have been less successful and plants are currently underutilized mainly due to the lack of twine and in some cases the machines installed are not flexible enough to meet changes in demand for the different twine materials, twine and mesh sizes.

Hardware and Accessories

65. Floats for fishing gear are now made mainly of synthetic materials and can be produced in any shape or size. The technology is simple and it would be possible for many to manufacture most types of floats locally, even if the chemicals have to be imported, rather than importing the finished article.

66. Other fishing hardware can be produced by any good smithery, foundry or workshop, with the possible exception of high quality fishing hooks.

67. Provided that steel rods and brass or copper tubing are available, swivels and related pieces of fishing tackle can be manufactured locally. This may be done with simple tools or with modern precision machines. In countries where semi-skilled labour is cheap, the former alternative would be adequate and production volume achieved by increasing the number of manufacturing units.

Small Manufacturing Units

68. It should be noted that it is often not easy for a country to obtain simple machinery for artisanal or cottage type industry. Commercial firms, particularly those selling in the international market, seek to promote the most modern and most sophisticated units. Production of simple tools or machinery is usually left to domestic manufacturing units or semi-charitable organizations dealing with appropriate technology. There is a need for technical assistance to establish manufacturing units at the intermediate technology level.

G. TRAINING, TECHNOLOGY TRANSFER, AND EDUCATION

Background

69. Training and technology transfer go together and are not truly transferred until the local industry can operate, maintain and repair the related equipment. Training should be practical and "hands-on" wherever possible. Often overseas institutes or organizations provide training at too academic a level and assume wrongly in most cases that the trainees are already skilled in all practical aspects of machining, welding, fitting and installing.

70. The introduction of new equipment and technology will call for the training of the operators as well as the manufacturers and service personnel. To achieve, this requires a coordinated approach involving governments and the business sector.

71. For the small-scale fishery sector, technology transfer can rarely be achieved without the support of a credit programme to enable the fishermen to purchase the new equipment. Few artisanal fishermen have access to institutional sources of credit and special programmes need to be devised to meet their needs.

Manufacturers

72. In general, the training needs will not be limited to the shopfloor worker who will have to deal with machinery and tools to which he or she is unaccustomed. Experience has shown that the training of managers, production engineers and administrative staff is equally important. Where there is a pool of skilled labour, it may only be necessary to give training on the product in question and so the setting up of a manufacturing unit could be accomplished in a short time. In other cases, the introduction of new industry would be a slow process involving overseas training and probably even university studies for those entering high technology industries; all of this in addition to the training of the work force locally.

Servicing

73. The servicing of equipment is a more immediate need since the service is directed to imported as well as locally produced items and in general there is currently a lack of servicing facilities. Factory trained service engineers are highly regarded and any manufacturer hoping to do well in a market must be prepared to ensure the training of field staff and of agents.

National Responsibilities

74. While manufacturers and service engineers have a responsibility to train in order to produce and/or maintain good quality products, governments have a greater responsibility. People with little education can be taught hand skills and such artisans will continue to be in demand, but new technologies in management, manufacturing and design are better transferred to those with a sound education. Governments have that responsibility.

H. CONCLUDING REMARKS

75. Bearing in mind that not all developing countries are ready or willing to accept the responsibilities which go with the manufacturing processes, industrial development in support of the fishing industry cannot and must not be seen in isolation. Shipyards worldwide are not known for their profit-making ability, and many are subsidized. Other manufacturing industries, which are more diversified, such as the makers of refrigeration equipment, oil hydraulics, engines and electrical equipment have a much wider customer base and yet must be

competitive to exist, and few, if any, rely entirely on the fishing industry. For these reasons the drive for self-sufficiency in all things must be tempered by the reality of any "potential" market. The aim of the fishing industry is to serve (by supplying protein-rich products) and to be served by its supporting industries.

76. There is scope for improvement at all levels, from the establishment of large numbers of small businesses in engineering and boat building to the upgrading of the larger shipyards capable of building deep-sea fishing vessels. In some countries progress will be slow, with the need for training and manpower planning on a long-term basis a priority element in the development process. Other countries which are technically self-sufficientwill be required to generate funding to meet their investment needs.

77. What is most likely to affect the rate at which the manufacturing processes can be transferred to developing countries will be the policies of the developed countries regarding trade, of the holders of patents and of transnational corporations.

78. Some transnational corporations have already embarked upon a programme of creating manufacturing units in developing countries. This is not usually motivated by the desire to help such countries. Instead it is a necessity to reduce manufacturing costs to remain competitive. For example, foreign firms have established plants in West Africa to make GRP vessels for local fisherman. They would have preferred to export from their base factories, but shipping costs would have added up to 100 percent to the cost of each boat. In other cases, the transnationals bow to the demands of governments, no submanufacturing, no business. However, such developments are not generally instigated by the fishing industry alone. It is more often the recipient of spin-off benefits which usually require further modification for use in the fisheries harvesting sector.

79. Experience has shown that manufacturing establishments in many developing countries have flourished best when the foreign partner supplying the technology has a continuing interest in the success of the national plant. In such cases the resources of the parent company are available to help the national firm with advice, training, maintenance, or raw materials.